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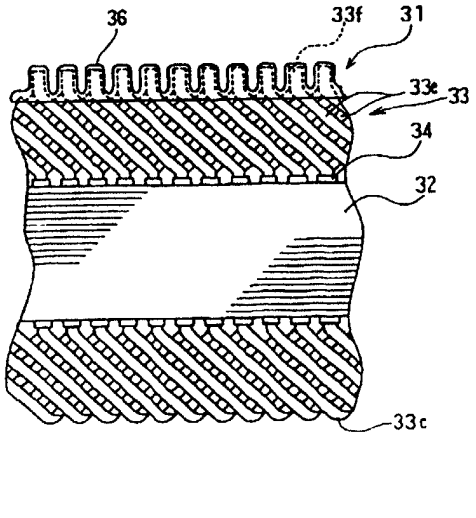
(54) AC generator stator for vehicle

(57) In an alternator for a vehicle, a stator winding is composed of a plurality of U-shaped conductor segments (33) and an annular member. The conductor segments (33) have connection edges (33f) connected to one another to form ring-connected coil-ends (31), and the annular member (36) covers the ring-connected coil-ends (31) at the connection edges (33f) and portions of the conductor segments (33) adjacent the connection edges (33f). The annular member (36) has a prescribed thickness that provides the ring-connected coil-ends (31) with a prescribed stiffness.

FIG. 4



EP 0 978 927 A1

Description

[0001] The present invention relates to an AC generator for a vehicle such as a passenger car, trucks or the like.

[0002] It is well known that a stator winding a vehicle AC generator is composed of a plurality of conductor segments as disclosed in JP-A-63-274335. Because the edge surface of coil-end portions and inclined intersecting portions of the conductor segments are covered with a thick and smooth insulation resin member except for straight portions extending from the stator core, it is difficult to cool the stator winding sufficiently. Because the straight portions are weaker in the circumferential stiffness than the intersecting portions, it is difficult to suppress vibration and the resultant noise.

[0003] A main object of the present invention is to provide an improved generator stator that is effective both in cooling the stator winding and in preventing vibration and the resultant noise.

[0004] According to a preferred embodiment of the invention, a stator comprises a stator core, a plurality of conductor segments composed of coil-end portions and in-slot portions forming a stator winding, and a ring-shaped resin member connecting the plurality of conductor segments. The plurality of conductor segments form inclined portions intersecting with one another and edge portions at said coil-end portions, and the resin member adheres to the edge portions in a circumferential direction thicker than the inclined portions.

[0005] Another object of the present invention is to provide an improved stator winding of an AC generator covered by an insulation member which is free from damage due to thermal expansion. The ring-shaped resin member may have a wave-shaped configuration corresponding to the outline of the ring-connected coil-ends. Accordingly, this structure protects the stator winding from water and prevents the connection edges from being oxidized and provides the prescribed stiffness as well as sufficient cooling spaces at the coil-ends. In addition, the annular member can have a uniform thickness so that cracks due to uneven thermal expansion can be prevented.

[0006] Other objects, features and characteristics of the present invention as well as the functions of related parts of the present invention will become clear from a study of the following detailed description, the appended claims and the drawings. In the drawings:

Fig. 1 is a cross-sectional side view of a main portion of an AC generator for a vehicle according to a preferred embodiment of the invention;

Fig. 2 is a perspective view of a conductor segment forming the stator winding;

Fig. 3 is a fragmentary cross-sectional view of the stator;

Fig. 4 is a fragmentary side view of the stator;

Fig. 5 illustrates connected portions of the conductor segments;

Fig. 6 is a fragmentary cross-sectional view of the connected portion;

Fig. 7 is a fragmentary perspective view of coil ends at both ends of the stator

Fig. 8 is a fragmentary perspective view of a variation of the stator;

Fig. 9 is a fragmentary cross-sectional view of a variation of the stator;

Fig. 10 is a fragmentary perspective view of the variation of the stator;

Fig. 11 is a perspective view of a conductor segment of a variation of the stator; and

Fig. 12 is a fragmentary plan view of the variation of the stator.

[0007] An AC generator for a vehicle according to an embodiment of the present invention is described in detail with reference to the appended drawings.

[0008] As shown in Fig. 1, an AC generator 1 for a vehicle according to a preferred embodiment of the present invention is composed of stator 2, rotor 3, frame 4, rectifiers 5 and others.

[0009] Stator 2 is composed of stator core 32, a stator winding having a plurality of conductor segments 33, insulators 34 disposed between conductor segments 33 and stator core 32, and resinous annular member 36 bonding edge portions 33f of coil ends 31 of the stator winding. Annular member 36 is formed from thermosetting epoxy powder as described later. Stator core 32 is composed of laminated thin steel-sheets and has a plurality of slots on the inner periphery thereof. Coil ends 31 is formed of conductor segments 33 extending from stator core 32.

[0010] Rotor 3 has pole core 7 with six claw poles, cylindrical field coils 8 housed inside claw poles, and shaft 6. Axial-flow type cooling fan 11 is fixed to the front side of the pole core 7 to supply cooling air from the front side of the pole core to the stator winding in axial and radial directions. Centrifugal type cooling fan 12 is also fixed to the rear side of the pole core 7 to supply cooling air from the rear side of pole core 7 to the stator winding in the radial direction.

[0011] Discharge vents 42 are provided at portions of frame 4 opposite coil ends 31, and intake vents 41 are provided at the front end of the frame 4.

[0012] As shown in Fig. 2, conductor segment 33 is a U-shaped member made of conductive material (e.g. copper). Conductor segment 33 has turn portions 33c, and an inner layer conductor portion 33a disposed in the radially inner layer of the slot and outer layer conductor portion 33b disposed in the radially outer layer of the slot. Each of inner and outer layer conductors 33a, 33b has in-slot portion to be disposed in the slot and the outside conductor extending outside of the slot to form a portion of coil end 31.

[0013] As shown in Fig. 3, each of inner layer conductor 33a and outer layer conductor 33b has a rectangular

cross-section having longer radial sides than circumferential sides. The conductor segments 33 are coated with insulation film 331 (as shown in Fig. 6). Conductor segments 33 are insulated from the inner walls of slot 35 by insulator 34.

[0014] As shown in Fig. 4, conductor segments 33 are disposed in stator core 32 so that all turn portions 33c are disposed at one axial end of stator core 32 and all edge portions 33f are disposed at the other end thereof. Inclined portions 33e of coil ends 31 inner layer conductors 33a are inclined to the direction opposite outer layer conductors 33b, so that inner layer conductor 33a and outer layer conductor 33b intersect with each other. Coil-end's edge portions 33f is connected with each other by an ultrasonic or arc welder, a brazing device, or the like.

[0015] Annular member 36 covers the surface area of edge portions 33f and limited portions of the inclined portion 33e adjacent edge portions 33f to bond or bridge edge portions 33, thereby providing coil ends 31 with enough stiffness against deformation and vibration.

[0016] Because annular member 36 covers portions adjacent inclined portions 33e, it provides sufficient cooling spaces of a net-work structure in coil ends 31, while it is tightly fixed to conductor segments 33 under vibrations and heat.

[0017] Annular member 36 also prevents edge portions 33f from being oxidized after they are welded as shown in Fig. 5. Otherwise, when the connected portions are welded together, connected portions A are melted, and the adjacent zones B are damaged or deteriorated with heat, to be subject to be oxidized.

[0018] As shown in Fig. 6, thin layer 361 is formed on the surface of annular member 36 to cover all the inclined portions 33e and fill small gaps between annular layer 36 and conductor segments 33 .

[0019] In manufacturing, insulators 34 are respectively inserted into the slots of the stator core 32, and conductor segments 33 are inserted into the slots inside insulators 34. As shown in Fig. 7, edge portions 33f are bent in the circumferential directions and connected as described before. Thereafter, thermosetting epoxy powder is applied to the portion indicated by A and B in Fig. 5, by way of fluidized-dipping, that include edge portions 33f and portions of inclined portions 33e, which are heated to form wavy annular member 36 as shown in Fig. 4. The wavy configuration of annular member 36 corresponds to the outline of the leading edge portions 33f. After that, the area of conductor segments 36 covered by the thermosetting resin powder is dipped in liquid resin and heated to form thin layer 361.

[0020] Since there is a difference in viscosity between the epoxy powder and epoxy liquid, coil ends 31 can be covered with comparatively a thick layer of the epoxy powder and sealed hermetically with epoxy liquid.

[0021] The connected portions of conductor segments 33 can be ball-shaped as shown in Fig. 8. This structure holds annular member 36 more tightly. This structure can be provided if edge portions 33f are welded by a TIG (tungsten inert-gas) welder.

[0022] It is important that the connected portions are larger in cross-section than that of conductor segments 36.

[0023] As shown in Figs. 9 and 10, the stator winding having four conductor segments 133 each slot 135 of the stator core 32 can also provide similar annular member 136.

[0024] The conductor segments can be shaped into a shape of I or J as illustrated in Fig. 11. Conductor segments 233 is composed of in-slot portion 233h, inclined portions 233i and leading edge portions 233f. In-slot portion 233h is inserted into slot 35, the inclined portions 233i extend from both ends of the stator core 32. At least one inclined portion 233i of two is bent from the shape indicated by broken lines after the conductor segment 233 is inserted into the slot.

[0025] As shown in Fig. 12, edge portions 233f are connected with one another and covered with the resin member 236.

[0026] The annular member (36, 136 or 236) can be separated to two or more portions. The resin member can cover wide area of inclined portions 33e if the thickness thereof is reduced, thereby maintaining spaces for cooling-air passages.

[0027] Bare conductor segments can be also used if each conductor segment is covered with insulator 34.

[0028] The connected portions are disposed only on the front or rear side of the stator core, so that the resin member 36 can be disposed only on one side of the stator core.

[0029] In the foregoing description of the present invention, the invention has been disclosed with reference to specific embodiments thereof. It will, however, be evident that various modifications and changes may be made to the specific embodiments of the present invention without departing from the broader spirit and scope of the invention as set forth in the appended claims. Accordingly, the description of the present invention in this document is to be regarded in an illustrative, rather than restrictive, sense.

Claims

1. An alternator for vehicle including a rotor (3), a stator (2) around outer periphery of said rotor (3), and a frame (4) supporting said rotor (3) and said stator (2), characterized in that

   said stator (2) comprises a stator core (32) with a plurality of slots (35), a plurality of conductor segments (33) composed of coil-end portions (31) and in-slot portions forming a stator winding, and a resin member (36) connecting said plurality of conductor segments (33),
   said plurality of conductor segments (33) form inclined portions (33e) intersecting with one

another and edge portions (33f) at said coil-end portions (31), and

said resin member (36) adheres to said edge portions (33f) in a circumferential direction thicker than said inclined portions (33e).

2. The alternator for vehicle as claimed in claim 1, characterized in that

said resin member (36) adheres thicker to an area of said conductor segments (33) between said edge portions (33f) and said inclined portions (33e) than said inclined portions (33e).

3. The alternator for vehicle as claimed in claim 1 or 2, characterized in that

a layer different from said resin member (36) also adheres to said inclined portions (33e).

4. The alternator for vehicle as claimed in any one of claims 1-3, characterized in that

said resin member (36) covers portions of said conductor segments (33) welded to each other.

5. The alternator for vehicle as claimed in claim 4, characterized in that

each of said conductor segments (33) welded to each other comprises a resin-film-coated wire exposed to welding pressure and heat to be damaged, and

said resin member (36) covers said resin-coated-wire.

6. The alternator for vehicle as claimed in claim 4 or 5, characterized in that

portions of said conductor segments (33) welded to each other are ball-shaped and are covered with said resin member (36).

7. The alternator for vehicle as claimed in any one of claims 1-6, characterized in that

said resin member (36) has wave-shaped configuration corresponding to the outline of the surface of said edge portions (33f).

8. The alternator for vehicle as claimed in any one of claims 1-7, characterized in that

said resin member (36) is annular.

9. The alternator for vehicle including a rotor (3), a stator (2) disposed around the outer periphery of said rotor (3), and a frame (4) supporting said rotor (3) and said stator (2), characterized in that

said stator (2) comprises a stator core (32) with a plurality of slots (35) and a stator winding composed of a plurality of conductor segments (33) having in-slot portions and coil-end portions (31),

said plurality of conductor segments (33) have connected portions welded to one another at said coil end portions (31), and

a resin member (36) adheres to said connected portion to increase stiffness of said coil-end portions (31) and protect said connected portions.

10. The alternator for vehicle as claimed in claim 9, characterized in that said conductor segments (33) are covered with a layer in addition to said resin material, and

said layer is thinner than said resin member (36).

11. An alternator for vehicle including a rotor (3), a stator (2) disposed around the outer periphery of said rotor (3), and a frame (4) supporting said rotor (3) and said stator (2), characterized in that

said stator (2) comprises a stator core (32) with a plurality of slots (35), a stator winding compose of a plurality of conductor segments (33), and a resin member (36) mechanically connecting said plurality of conductor segments (33),

said plurality of conductor segments (33) have edge portions (33f) circumferentially disposed on said coil-end portions (31),

said resin member (36) circumferentially adheres said edge portions (33f) to bond the same in a wave-shaped configuration corresponding to surfaces of said edge portions (33f).

12. The alternator for vehicle as claimed in claim 11, characterized in that

said conductor segments (33) are covered with a layer different from said resin member (36), and

said layer is thinner than said resin member (36).

13. The alternator for vehicle as claimed in claim 11 or 12, characterized in that

said coil-end portions (31) include intersecting portions intersected with each other and alignment portions aligned in the axial direction of

stator core (32), and

said resin member (36) covers conductor segments (33) from said alignment portions to said intersecting portions.

FIG. 1

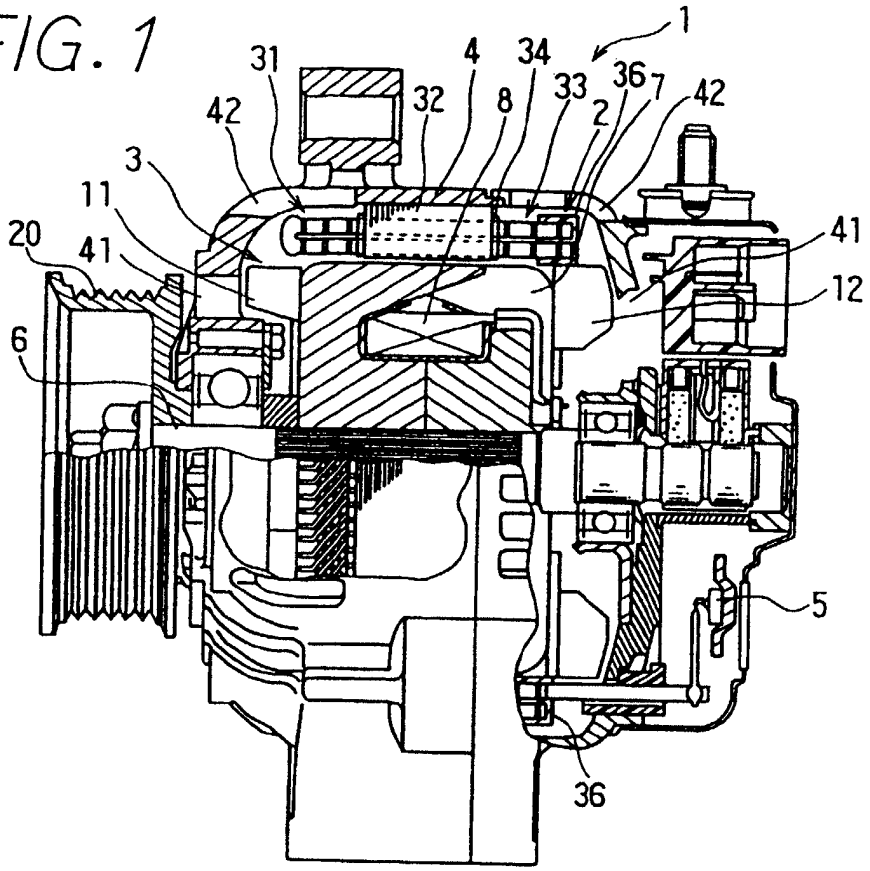


FIG. 2

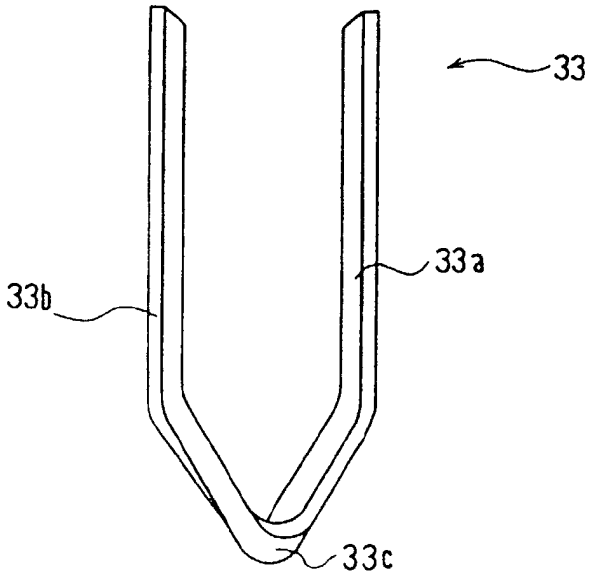


FIG. 3

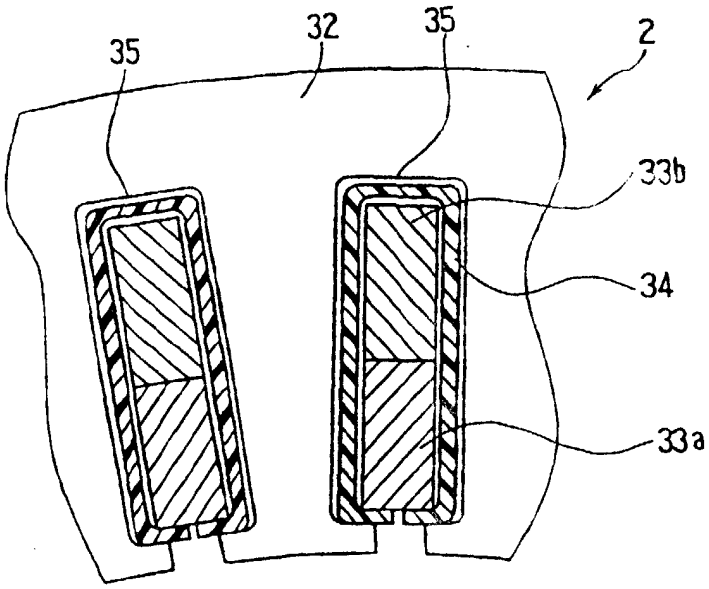


FIG. 4

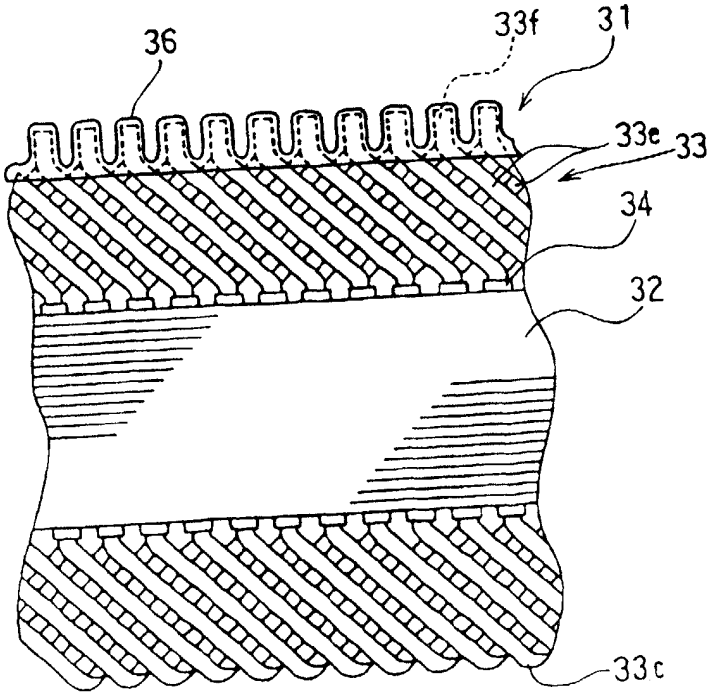


FIG. 5

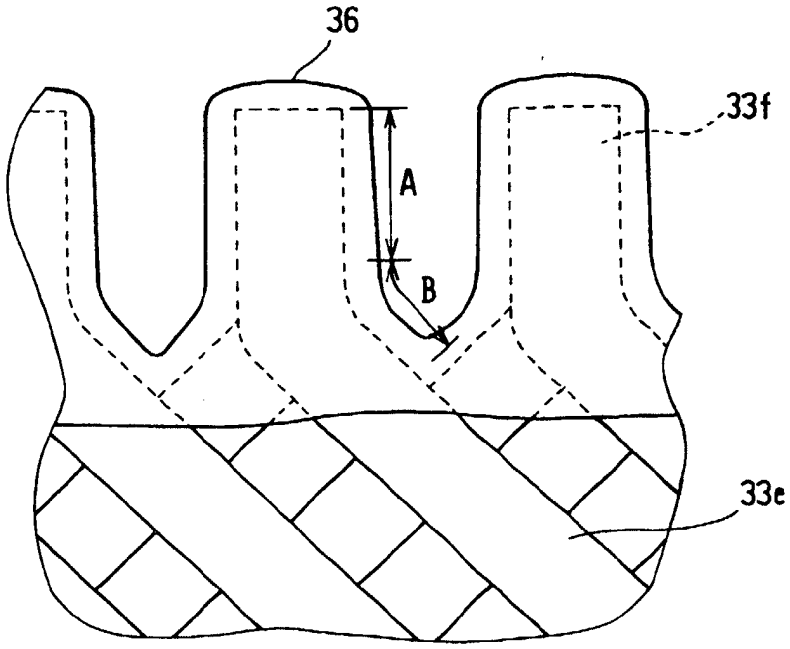


FIG. 6

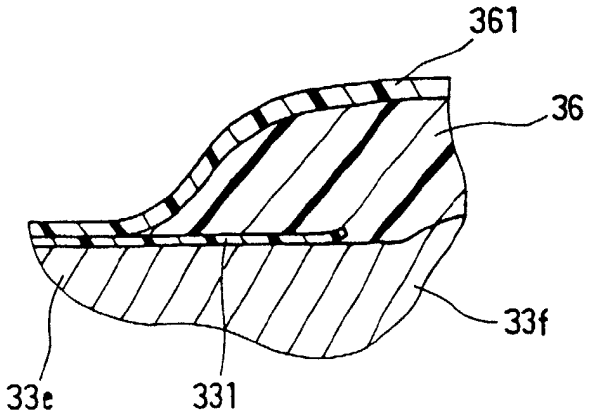


FIG. 7

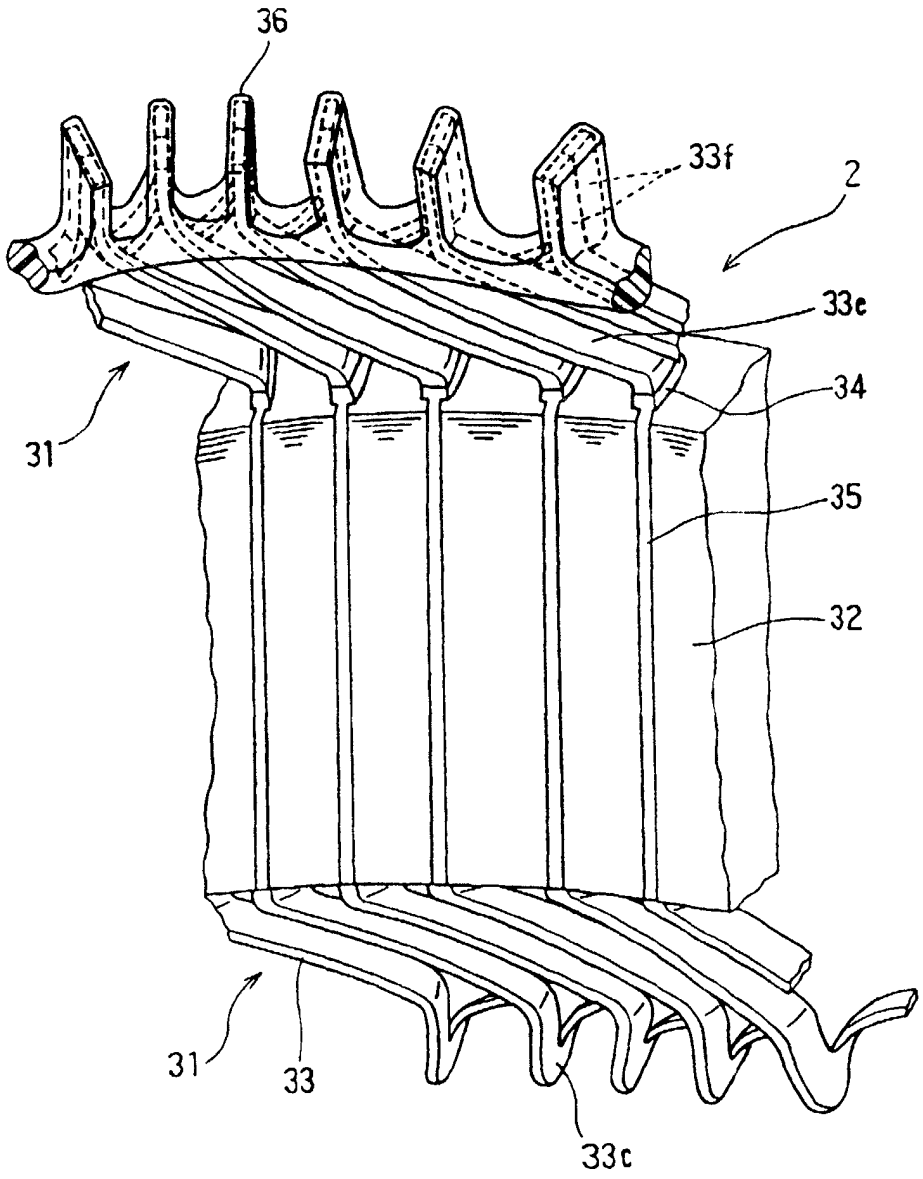


FIG. 8

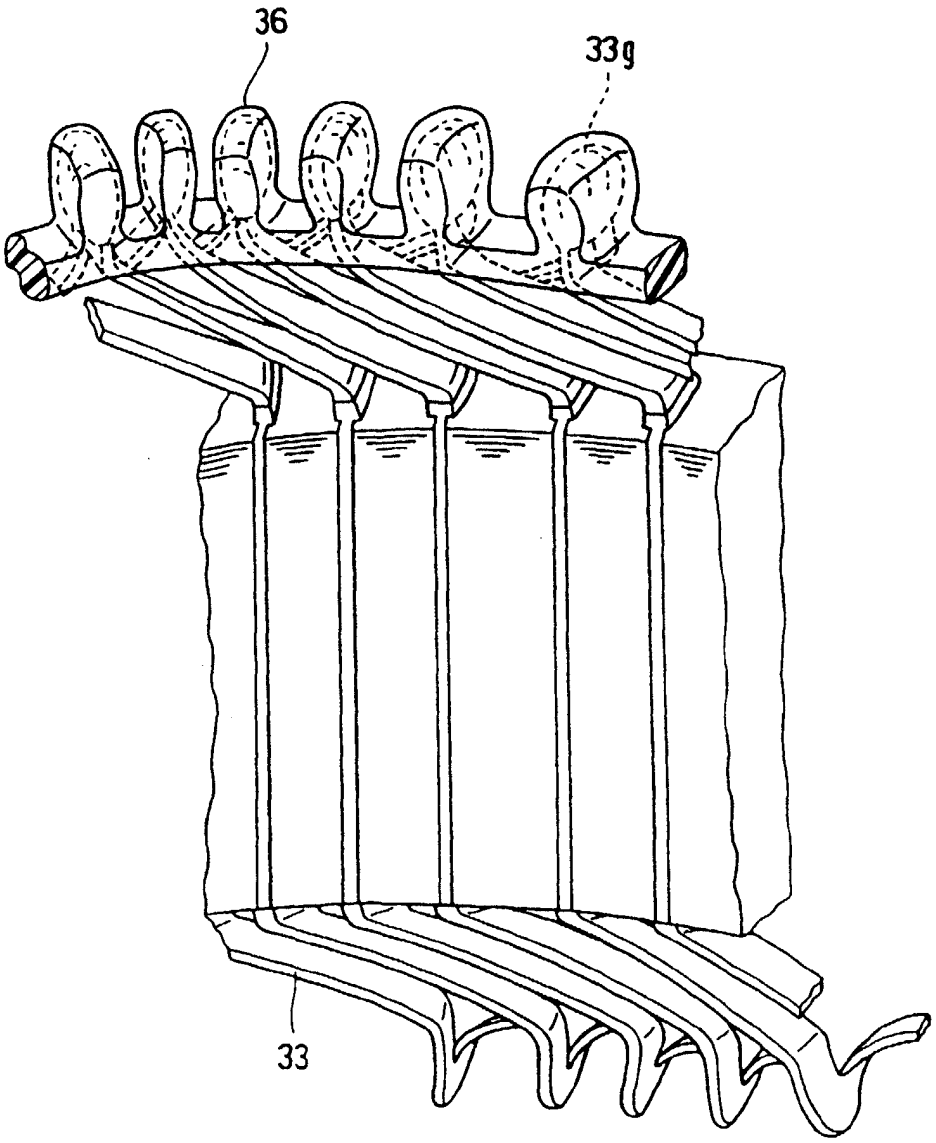


FIG. 9

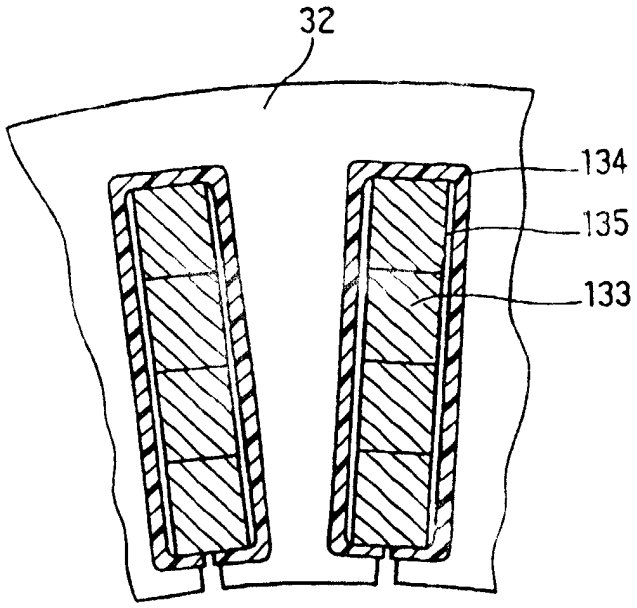
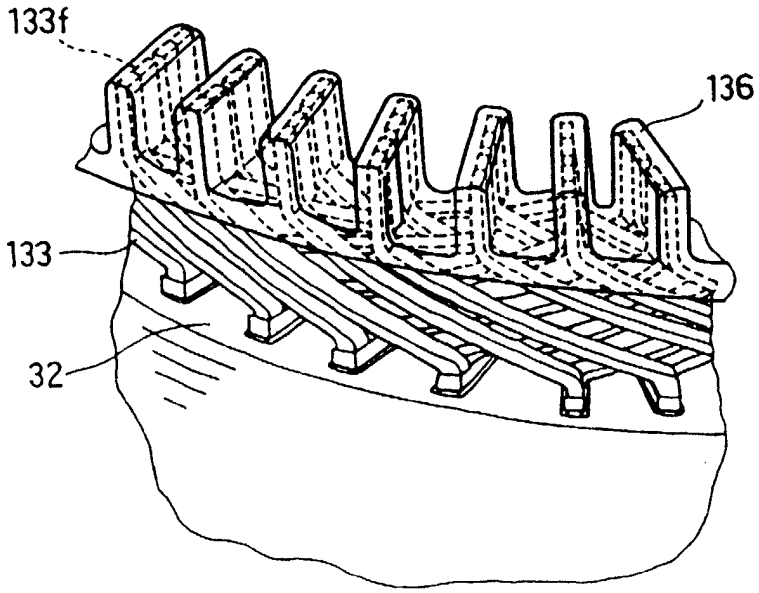


FIG. 10



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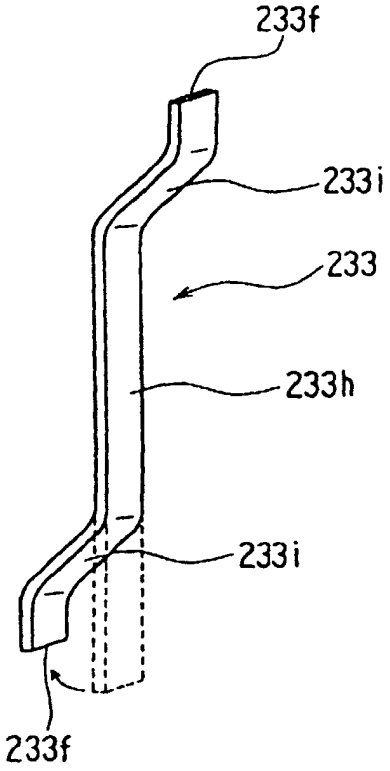
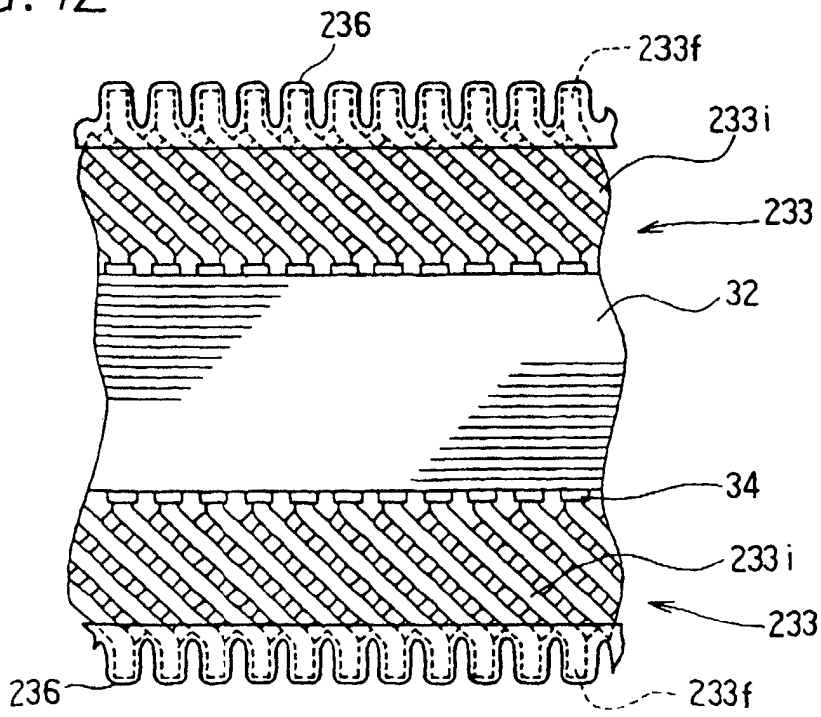

233f
233i
233
233h
233i
233f

FIG. 12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European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 99 11 0423

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A,D	PATENT ABSTRACTS OF JAPAN vol. 013, no. 103 (E-725), 10 March 1989 (1989-03-10) -& JP 63 274335 A (NIPPON DENSO CO LTD), 11 November 1988 (1988-11-11) * abstract; figure 3 *	1,9,11	H02K3/50
A	US 3 151 260 A (D. C. MAC CRACKEN ET AL) 29 September 1964 (1964-09-29) * column 3, line 23 - column 4, line 36; figures 1,2 *	1,9,11	
A	DE 195 29 392 A (BOSCH GMBH ROBERT) 13 February 1997 (1997-02-13) * abstract *	1,9,11	
A	US 3 400 454 A (BALKE ROY L ET AL) 10 September 1968 (1968-09-10) * column 3, line 56 - line 62; figure *	1,9,11	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7) H02K

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	11 November 1999	Zanichelli, F

CATEGORY OF CITED DOCUMENTS

X particularly relevant if taken alone
Y particularly relevant if combined with another document of the same category
A technological background
O non-written disclosure
P intermediate document

T theory or principle underlying the invention
E earlier patent document, but published on, or after the filing date
D document cited in the application
L document cited for other reasons

& member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 99 11 0423

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

11-11-1999

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 63274335 A	11-11-1988	NONE	
US 3151260 A	29-09-1964	NONE	
DE 19529392 A	13-02-1997	ES 2116232 A	01-07-1998
		FR 2738414 A	07-03-1997
		GB 2304236 A,B	12-03-1997
		IT MI961677 A	02-02-1998
		JP 9103038 A	15-04-1997
US 3400454 A	10-09-1968	NONE	

EPO FORM P0459

For more details about this annex see Official Journal of the European Patent Office, No. 12/82

Patent Abstracts of Japan

PUBLICATION NUMBER : 58072358
PUBLICATION DATE : 30-04-83

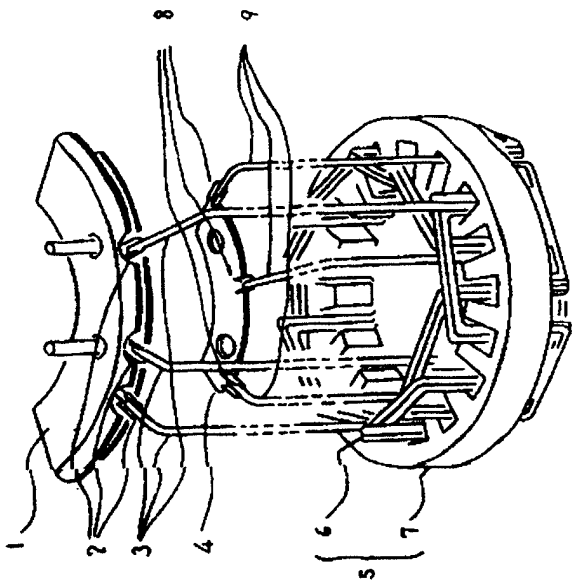
APPLICATION DATE : 23-10-81
APPLICATION NUMBER : 56168783

APPLICANT : HITACHI LTD;

INVENTOR : ONOE AKIHIKO;

INT.CL. : H02K 19/36 H02K 3/50

TITLE : AC GENERATOR



ABSTRACT : PURPOSE: To simplify the bonding work of a neutral wire of a stator coil by extending the coil ends of a stator in the state that the positional sequence is maintained, and bonding the end to become a neutral wire of them through a bonding auxiliary material having electrical conductivity.

CONSTITUTION: An AC generator has a rectifier 1, a stator 5 and a bonding auxiliary material 4 for a neutral wire. Each coil end of the stator 5 is extended in the state that the positional sequence is maintained, and the end to become a neutral wire 9 of them is bonded through the material 4 having electric conductivity. A rectifying connecting terminal 2 which connects rectifying wirings 3 from the stator 5 is provided at the rectifier 1. A neutral wire connecting terminal 8 which connects the wire 9 is provided at the material 4. The wirings from the coil ends of the stator 5 and hence the wirings 9 and wirings 3 are extended while maintaining their positional sequence. The stator 5 is composed of a stator core 7 and coils 6.

Patent Abstracts of Japan

PUBLICATION NUMBER : 63294242
PUBLICATION DATE : 30-11-88

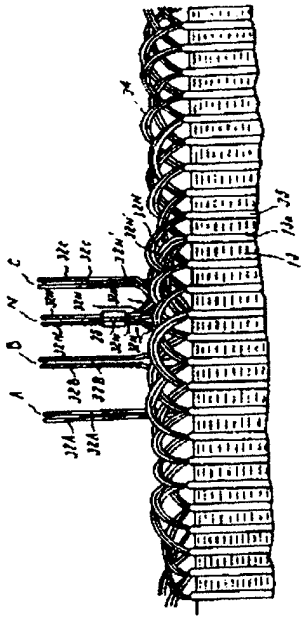
APPLICATION DATE : 26-05-87
APPLICATION NUMBER : 62130223

APPLICANT : MITSUBISHI ELECTRIC CORP;

INVENTOR : YOSHINO SOICHI;

INT.CL. : H02K 19/36

TITLE : STATOR OF AC GENERATOR FOR VEHICLE



ABSTRACT : PURPOSE: To bond neutral point side leading-out ends easily and positively by focussing the neutral point side leading out ends at one position, mutually fixing them and connecting them to a commutator.

CONSTITUTION: Each neutral point side leading-out ends 32N, 32N' for three- phase armature coils are led out directly up to sections among leading-out terminals for these three-phase armature coils. These led-out neutral point side leading-out ends 32N, 32N' are bundled at one position, and fastened mutually by a focussing fitting 25. A leading-out terminal N connected to a commutator through the bundling fitting 25 is protruded. Other sides of the armature coils are led out as leading-out terminals A~C.

Patent Abstracts of Japan

PUBLICATION NUMBER : 11150904
PUBLICATION DATE : 02-06-99

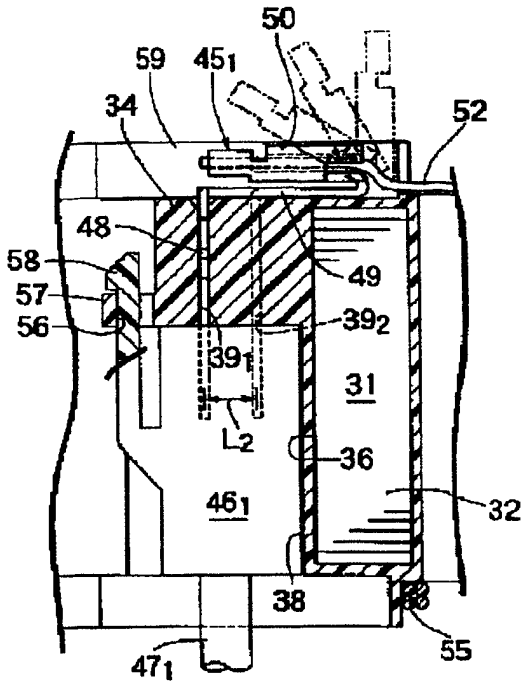
APPLICATION DATE : 13-11-97
APPLICATION NUMBER : 09311835

APPLICANT : HONDA MOTOR CO LTD;

INVENTOR : SHINKAWA YASUHIRO;

INT.CL. : H02K 3/52 H02K 3/46 H02K 21/22

TITLE : CONNECTING TERMINAL FOR STATOR



ABSTRACT : PROBLEM TO BE SOLVED: To reduce manhours in work, by facilitating the connection work of a coil to a connecting terminal, and lessen the arrangement space of the connecting terminal, in the case that the connecting terminal for a stator is set and fixed in the engagement hole provided at the bobbin that the stator has so as to connect the coil of the stator with external lead wires.

SOLUTION: A connecting terminal 451 comprises a terminal part 58 for connection of external lead wires which is set and fixed in an engaging hole 391, a plate shaped coupling plate part 49 which ranges at a right angle from the other end of this terminal part 48 for connection of external lead wires, and a terminal part 50 for coil connection which is capable of bending to lie upon the coupling plate part 49 and extends in the direction parting from the bobbin 34, ranging at a right angle from the other end of the coupling plate part 49. Then, the terminal part 50 for coil connection is made in a tubular form, enabling a lead wire 52 extending from the coil to be passed and also enabling the lead wire 52 to be fuse-connected to the tip.